GEOGRAPHIC CRITERIA IN REDISTRICTING TEXAS 2001, 2003

THESIS

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CHAPTER I

INTRODUCTION

Background of Issues

The United States Constitution requires that a census will be taken every decade to estimate the population as accurately as possible, and to describe various demographic characteristics of U.S. citizens. One of the important uses among the states from this nationwide data collection is for allocating the seats in the U.S. House of Representatives. Following this task, states' legislatures must redraw the boundaries of each district throughout their states in order to have no more than one representative per district. The main purpose of redistricting is to ensure that each district is comprised of an equal number of constituents as possible so that each citizen is represented fairly (Morrill 1981). The concept and application of redistricting is part of our United States heritage, and may be traced to the beginning of this nation. The first attempts to establish "fair" election districts for electoral purposes were made with the intent to strictly conform to the "equal population clause" in the U.S. Constitution.

Before the social and political turmoil of the 1960s, some Americans were aware that "fair" electoral processes were imperfect and reform was necessary. The purpose of this study is to demonstrate that, although the "one man, one vote" doctrine was seen to

be the "fix" to ensure fairness in voting, this has not necessarily been the case; the need has arisen for the development of additional, more sophisticated, standards for establishing "fairness." To accomplish this, some states have developed a set of criteria in an attempt to address issues related to fairness. The mapping of "fairness" criteria along with population demographics through the use of a Geographic Information System (GIS) provides a useful tool for spatially analyzing how redistricting might be achieved in an equitable manner. Thus, this study employed data from historical redistricting records, combined with the methods used in framing GIS to explain the history of more recent issues related to redistricting "fairness" that is being dealt with in our nation today.

Since the Voting Rights Act in 1965, this country has been more conscientious in demanding fairness in all aspect of elections and districting, especially in maintaining compliance with the Fifteenth Amendment, which gives each citizen equal voting rights (Webster 2000). With the invention of modern computers and their applications in establishing criteria to which ensure fair elections, state legislatures have been able to explore new ways to create truly "perfect" districts.

To accomplish the feat of creating a more "perfect" district, a series of criteria has been written by both the Federal and state governments. The forerunner in this area of research was a state -appointed master geographer from the State of Washington, Richard L. Morrill. Morrill was appointed to redraw the district lines for the State of Washington in 1972. Much debate had preceded the efforts of Morrill and others for using computers in the redistricting process. In the early 1970s, Americans had not yet begun to trust computer models as being "fair" and representative of human cartography. Others, like Morrill, employed computers as a tool for redrawing district lines as opposed to

traditional methods (Morrill 1973). By the late 1960s, a considerable effort was made to create "scientific" districts-- those without human biases and errors. (Shelley 1996, 177)

The criteria described for redistricting is often vague and falls prey to diverse interpretations, as demonstrated by the numerous state and federal court cases, which demand the redrawing of new boundaries. This includes the recent 2003 attempts to redraw district boundaries throughout the State of Texas, which is the focus of this research. However, the problems and strife caused by the redrawing of district lines in Texas and other states, as well, extended beyond the task of simply creating new district lines; it also dealt with combative political parties and other political action groups. Although the Republicans and Democrats in the Texas legislature were not in agreement on the drawing district lines, the issues went farther than party disputes or partisan politics. Elected officials in both the Texas House and Senate were seen as attempting to protect their offices, and more importantly, keeping the district lines in a place which allowed the integrity of their represented districts to remain stable.

This study, hereafter referred to as "fair districting" research, discusses and evaluates the previous two sessions in 2001 and 2003 of the State of Texas Congress to assess whether these districts were drawn "fairly" based on established criteria to allow racial minorities their equal representation which is allotted to them in the Constitution. I built on the "Fair District Criteria Theory" based on the precepts of this theory to assess whether developing "fair" criteria was possible in these two sessions of the Texas legislature. The focus for this research is concentrated on the geographic criteria of compactness and contiguity. Compactness may be defined in a variety of ways among states. Unfortunately, the State of Texas gives no clear definition of what is expected

from the compactness criteria. Thus, this study assumes that compactness is defined in terms of the sum of its perimeters of district boundaries and a description of the irregularities in district shapes. (Grofman, 1985 and Altman, 1998). In an online document the TLC states that Geography reports were made and included the geographic criteria. They say that geographic data are compiled, including compactness, but since no real consensus can be made on what measurement to use the data will only be "eyeballed" and taken into consideration by each person who is in charge of an area in the redistricting process (TLC 2, 7).

Statement of Research Issue

The question that guides this study is as follows: what role does the geographic criteria play in the determination of the "fairness" of a district and in the establishment of a 'fair' district?

Compactness of districts is an indicator that can be used to ensure that districts are attempting to be "fairly" created as to not allow some gerrymandering. The 14th Amendment requires the government to equally apply the law to every individual. *Baker vs. Carr* used 14th amendment as a guide, since that time researchers have looked at criteria that can measure "fairness" of a district or that can help establish 'fair' districts. To summarize, the research found that there are four areas of criteria that must be addressed to create a fair district: Constitutional criteria, Geographic criteria, Political-Geographic criteria, and Political criteria. This research focuses on the geographic criteria of compactness and contiguity.

The criteria established according to the precepts of "Fair Districting Theory", in the perfect world, are complementary in nature, and if we were in a perfect world, they

would easily be combined to create a "fair" district; however, the possibility of combining all the criteria onto one map with multiple districts is impossibility. All the criteria are so different in nature that with the combination of all of them onto one map weaken the effectiveness of other criteria of a different nature. This research investigates the 2001 and 2003 Texas legislature's attempt to redraw redistricting boundaries, and assesses the boundaries against criteria set forth by the state to create "fair" and legal districts. This criterion reads as follows:

> "The state legislature will reapportion the state into senatorial and representative districts during the first regular session after the release of the decennial census. The districts must be contiguous and equal or nearly equal in population…the new districts shall be effective at the next state-wide general election" (Texas Constitution Article 3, section 28).

In addition, this case study utilizes criteria according to FDC Theory, which are as follows are:

Constitutional criteria:

1. Equal distribution of population
2. Equal probability of representation using the variable of "racial equality"

Geographic Criteria:

3. Compactness and contiguity
4. Integrity of political boundaries

Political-Geographic Criteria:

5. Representation of political units
6. Integrity of political boundaries

Political criteria:

7. Altering the system as little as possible
8. The issue of political gerrymandering: whether, partisan and bi-partisan; achieving a balance of safe and competitive districts; responsiveness (Morrill, 18, 1981).

Specifically, this research focuses on the geographic criteria of compactness and contiguity. The emphasis is placed on these two factors due to a general understanding

that . . . "most proponents of compactness measures offer them as a means to prevent electoral manipulations" (Altman 1998, 1).

Statement of Hypotheses

The null hypotheses that guide this study are as follows:

1. The geographic criteria for redistricting (compactness and contiguity) do not play an instrumental role in establishing "fair" redistricting boundaries.
    a. Compactness measures that are currently used do not provide a benchmark for interpreting the 'fairness' of district boundaries.
    b. Contiguity cannot be determined by simply looking at a map of districts the underlying geographic features must be examined to determine whether or not a district is contiguous

With the use of the Fair" District Criteria Theory, the 2001 and 2003 State of Texas legislature is studied and thoroughly examined, focusing especially on issues of compactness and contiguity.

Importance of the Study

This study evaluates the 2001 and 2003 Texas district maps to:

- Demonstrate how GIS can be used to evaluate the compactness measures that are used
- Critique the Webster's interpretation method of the measurements of compactness

- Provide a non-partisan Evaluation of the two district plans in terms of fairness.

This 'fair' district research focused on the geographical elements of "compactness" and "contiguity" to illustrate how incorporating the mapping of spatial factors in the decisions to redraw redistricting boundaries is a useful device for ensuring that "fair" criteria are met and utilized. The more compact a space is the shorter distance from other locations that are homogenous to that space. Simply put, the closer two things are the greater the chance that they are similar. Though a great deal of social science research has been performed on this topic, very little has been offered from the geographical perspective. Most research emanates from political science, which strictly deals with the legal aspects of the problem of establishing fair criteria to establishing Congressional districts. Geographic methods and techniques allow a more comprehensive perspective, which include important spatial information to the process that beyond just simple "geographically homogenous districts created" (Lazinos, 56). This previously mentioned thesis looked at the standards in reapportionment and redistricting, Lazinos' thesis considered only her perspective as a political scientist. It viewed regions delineated by similar topographic features be considered the only geographic district indicator (Lazinos, 57).

Scope and Delineation of the Study

The scope of this "fair" district research is delineated by a strict examination of the geographic criteria as it was applied to 2001, 2003 sessions of the Texas Congress, specifically the measurement of the compactness of districts.

This research is limited in several ways. This research uses existing compactness measures and does not evaluate or critique their usefulness in measuring compactness. In other words, it is assumed that the current compactness measures provide an adequate measure of compactness. In addition, this study only looks at the geographic criteria of compactness. Readers should keep in mind that other criteria are also important in evaluating the fairness of a district. The geographic criteria focus specifically on the shape of the district and the expanse that its area is dispersed around its core (Webster, 2004).

CHAPTER II

HISTORICAL BACKGROUND

The Pioneer Work of Richard Morrill

To accomplish the more "perfect" district, the Federal and State Governments wrote a series of criteria. The forerunner in this area of research was a state appointed master geographer in Washington, Richard L. Morrill. Morrill was appointed to redraw the district lines for the state of Washington in 1972 (Morrill, 1973). Much debate had preceded this effort. Morrill employed a computer as a tool to redraw lines in the short time of two months, although, Americans had not yet begun to trust computer models as being "fair" and representative of human cartography. The redistricting in Washington State by Morrill applied a "variety of geographic criteria including: compactness and contiguity, integrity of well-known units (counties and cities); and, consideration of natural geographic boundaries to delineate functional unity and cultural homogeneity, rather than a political criterion of partisan advantage to particular parties." Morrill discusses the theoretical bases for apportionment as a central focus of his criteria for his redrawing of district lines (Morrill, 1973).

The constitutional criteria has been determined over the course of several court decisions resulting in a constitutional amendment for "equal protection" for basically equal population in districts, with a one percent deviation. The political criteria are in two

categories of the relation of electoral districts to governmental units, especially at the county level and the question of partisan political balance. Counties are created by the state and their administrative powers are changing constantly. Morrill states that the patterns of administrative alterations might theoretically permit any number of arbitrary inequities in representation. The state and Supreme courts around the country have held the counties to be encompasses within the fewest number of districts as possible, some what in an attempt to defend against gerrymandering. As in the case of this "fair" district research, Morrill's research suggests the possibility that a plan might be created with compact districts of equal population but the strength of one party's voting is greater and more concentrated in one area and is therefore "wasted" in an area that is safe and assured to be one by the party (Morrill, 465).

The geographic criteria have generally been geometric so to keep districts as compact as possible, which is to obviously minimize the possibilities of gerrymandering. However, how "fair" is it to have areas that are racially similar from a technical standpoint? A very important point is brought up by Morrill, who states that rarely have there been times that geographic criteria have become the major criteria for reapportionment, although geographers might argue that geographic criteria should be considered most important all the time. The geographic criteria instill the idea that districts should be more than random collections of people, and should have some unity or collectiveness between the residents of the area. The major problem is the dilemma presented by the choice between uniform and functional regions, and the consistent problem that not even these regions divide themselves into areas of equal population. Morrill states that it in all probability it might have been easier to create a smorgasbord of

districts if the American "melting pot" might have been more equally distributed. In reality, the overwhelming fact is that people tend to congregate with others that are like them. Morrill uses the example that has been all over in the redistricting literature, that if there were four people of a minority and six of the majority, the most likely scenario is that the majority candidate might be elected although his district might consist of more than just the majority people. The trick is to get 40% of the elected officials to be minority and 60% to be the majority. This scenario is included in the perfect "fair" district, equal representation for all. Another example of this situation will be presented. Morrill, on the basis of his own experience, recommends these four ideas for redistricting: 1) a relaxation of the equal population criterion to perhaps a three to five percent deviation; 2) retention of contiguity, compactness, integrity of counties or cities and natural geographic barrier criteria, without excessive rigidity; 3) inclusion of a meaningful region criterion, again without rigidity; and 4) exclusion of political criteria in the redistricting process itself but probable use in evaluation of the fairness (political balance) of plans.

In a follow up article, Richard Morrill discusses the ability of comparison of two redistricting plans. Morrill, in agreement with the plan of this study, states that results are compared and specifically look at efficiency, compactness and distance-minimization, and reasonableness, which is the extent to which the plan respects the geographical regions (Morrill, 1976, 548). Focusing on the 1972 and 1974 elections, his study compares the optimal computer models of the redistricting and the actual models that were done by hand. He looks at what the patterns of districts would have looked like if the computer models had been used. His conclusions drawn were that the computer

version of the districts was more accurate because either the manually drawn maps were unable to show the most efficient patterns or that they intentionally emphasized other criteria dramatically so to preserve the districts and not change them too much (Morrill, 1976, 556).

Issues in Redistricting

O'Loughlin discusses the identification and evaluation of racial gerrymandering. His article begins with a paragraph that sums up the situation that he was researching about in 1982 and it sums up almost to the exact situation that is being discussed about in his other paper in 2003. "The decennial political struggle over legislative reapportionment is currently underway in the American states. Changes in district lines are accompanied by claims of threatened incumbents, of minorities seeking representation in proportion to their numbers, of reform groups urging nonpolitical computer redistricting, and of editorial writers condemning the unseemly partisan spectacles" (O'Loughlin, 1982, 165). He discusses the fact that redistricting has to be designed to meet the "one-man one-vote" requirement, which is more complicated than was once thought. He continues to define gerrymandering as "the biased district lines designed to help a group and hurts its opponents" (O'Loughlin, 1982). The belief that gerrymanders are not difficult to identify is shown not to be true based on the history of the court decisions on the gerrymandering difficulties. This "fair" district research shows that the problems discussed in the O'Loughlin article are similar and these include: the lack of legal and technical standards and application of the criteria set forth by the government will doom challenged maps of gerrymandering. This author found the same problem in 1982 that has been found true today that equal population is the only criteria

that are typically considered; the other criteria are rarely looked at on a consistent basis. A major confirmation between this "fair" districting research and the work of Lijphart's paper is that the possible sixteen criteria listed are aiming to create "fair and effective representation" but they tend to contradict each other (Lijphart, 1982 and O'Loughlin, 1982). Lijphart says that fair representation is the oldest theory of democratic representation; this theory holds as fundamental that the elected representatives should reflect the interest, opinions, and characteristics of their electors as much as possible. In his list of criteria, which is more exhaustive than the criteria in this research but does it include the criteria that is stated in this "fair" district research, the statement is again made that, although the individual criteria can be satisfied individually, they cannot be satisfied simultaneously with the constraints of the system in which they are created and the geographically defined districts. The different criteria lead to different recommendations for the kind of districts that should be created to represent the criteria (Lijphart, 1982, 147).

This excerpt comes for a dialogue between two Senators and constituent in 1979, they were discussing the representation issues and what was happening twenty-five years ago in the Congress.

Senator Danforth: I don't know how many black members there are in the Congress. Maybe you do.

Mr. Wells: I don't know the actual figure, no.

Senator Danforth: But it is roughly fifteen, something like that, whereas it is about 10 to 11 percent of the population of this country is black. So, they are about one third of what their representation would be (15/435 = 3.4 %)

Senator Levin: Suppose it could be shown that to use what amounts to the chance method is going to result in even a lower black representation. I don't see how that is possible.

Mr. Wells: I agree with you, Senator. I don't see how it is possible. Even if it is possible in one particular district, it may not be in the next one. That is the beauty of operation on a chance pattern.

In the long run, if I understand mathematical logic, a chance pattern will, over the long haul, operate in such a way as to make the percentage of the population and the percentage of representation more or less equal. It may not do that in any given redistricting arrangement. But, in looking at it over a series of years, it should accomplish that (Grofman, 1982, 55).

Grofman discusses that when this conversation took place in 1979, the view might have been that the possibility for equal representation was not taken so seriously and that the representation was more or less equal. Today, equal representation has been demanded, with the case in point in Texas during this last redistricting. The Hispanic population demanded that they have equal representation. The courts were appointed to determine if they were short-districted, it was found that the Hispanic constituency lacked evidence showing they were mistreated, purposely (Grofman, 1982). This is to say that if 40% of the people that live in a state are Hispanic then the representation should reflect that with 40% of the representatives should be represented.

Compactness and Contiguity

Compact districts were at one time in some states a federal statute and required for congressional redistricting, but this is no longer true. Compactness has never been a requirement for state districts, but the federal courts have on more than one occasion stated the desirability of compact districts. If there were a requirement for the definition of compact districts, it would be that compact districts are districts that have the boundaries of each district as short as possible (Grofman, 1982, 16). As many as twenty five states have compactness in their constitutions, as a modified phrase like, "as

practicable" or "as possible" or with some vague language such as this (Grofman, 1985, 85). From the literature available by the Texas Legislative Council, it is unclear if any of the compactness measures are used consistently in redistricting procedures. Nonetheless, there are up to thirty measurements of compactness that are used or have been used to judge compactness in the states. "Formal compactness measures are the mathematical functions that describe irregularities in district shape of population distribution. In other words, these are measurements used to detect 'ugly' districts, or formulae used to generate 'pretty' ones. Most proponents of compactness measure offer them as a means to prevent electoral manipulation" (Altman, 1998, 989). Strict adherence to the compactness guidelines should be avoided because a district full of perfectly symmetrical circles and squares might be used to do the very thing that they are meant to deter, i.e., it might allow the cover of an easy gerrymander to submerge an important group of the electorate. In reality, though, the absolute compactness in any area is an impossibility, and as compactness is a shape requirement, these focus more on form of the lines than to the substance of "effective political representation" (Grofman, 1982, 16).

Morrill specifically discusses the issue of compactness and is an advocate of the geographic criteria specifically compactness. He states that researchers of "electoral abuse have stressed compactness both as inherently desirable and as a defense against gerrymandering" (Morrill, 1981, 21). He continues to suggest that the geographic criterion has become a major criterion for evaluating district plans (Morrill, 1981, 21). There are those who do not agree that this criterion needs be upheld as an important one or even as one that should be enforced or used at all. In a Mississippi case in 1977, *Connor vs. Finch,* the court relied heavily on the analysis of the "non-compact" districts

to justify the ruling to allow the irregularity (Morrill, 1981, 21). The compactness issue is legally stressed because of the "equal representation" mandate, not for the interest of any other political parties. Morrill advocated the important point that should definitely be kept in geographer's minds, that the physical shape of a district is much less important than its behavioral shape or sense of integrity (Morrill, 1981, 23).

Mark Monmonier is also a major player in this game of researching redistricting issues. He dedicated an entire chapter in his book to "Gauging Compactness" (Monmonier, 2001). He states that "it is tempting to suggest a formal standard for compactness: a definition separating the illegally irregular from the geographically gauche…although we know it when we see it, individual sensitivities and community standards vary widely" (Monmonier, 64, 2001). He as well as Webster presents the fact that there are two-dozen different measurements of compactness but there are two that are the most widely used and complementary to each other that will result in a description of the irregularities of political districts. These indexes are simple formulas that are based on simple geometric definitions, like a circle and a perimeter, which will result in the basic "dimensions of a closed geographic boundary" (Monmonier, 65, 2001).

The two indexes that Monmonier discusses are dispersion score and perimeter score. These indexes was used in this "fair" district research. Dispersion score is measured by dividing the area of a district by the area of the smallest circle that totally surrounds the district. The circle is used for a guide in compactness because it shows considerable features between shapes that are compact and those that are thin and irregular elongated shapes. The drawback for this index is that it does not measure the irregular boundaries of the district (Monmonier, 2001).

The second index is the perimeter score and it is gauged by dividing the area of a district by the area of a circle with a circumference equal in length to the perimeter of the district. This score measures the efficiency of a district's boundaries. Perimeter score captures an element of shape distinctly different from a boundary's overall circular fullness as measured by the dispersion score (Monmonier, 66, 2001). The difficulty of using any measurement index is that this is a complicated multifaceted problem to measure and meaningful compactness index need to be able to differentiate the difference between a meandering river and an intentional squiggly lasso to capture minority groups into a district (Monmonier, 2001). These are the issues faced in the measurement of the geographical criteria of compactness.

Background and Context: Contention in the Texas Legislature over Redistricting

Criteria set for the drawing of district lines are vague, and at the same time impossible to coordinate, for accommodating each criteria within the same map. This accommodation created major divisive issues in the State of Texas during the legislature's redistricting attempts in 2003. Political parties fought bitterly over issues, which eventually necessitated involvement of the Texas Supreme Court. The main issue of contention was the allegation that the Republican Party was trying to gain control over districts by gerrymandering districts solely based on racial discrimination.

The Texas State Constitution states that redrawing of district lines must be completed in the first regular session following the publication of a United States decennial census (Texas Constitution Article 3, section 28). If for any reason the legislature cannot agree on the redistricting, a Legislative Redistricting Board is to be created of five set members: the Lieutenant Governor, the Speaker of the House of

Representatives, the Attorney General, the Comptroller of Public Accounts and the Commissioner of the General Land Office. If this committee cannot arrive at any decision with in 60 days of its creation, the Federal courts have jurisdiction to compel the Board to perform its duties.

The most recent case of this failure to create satisfactory redistricting lines, caused bitter feuding that resulted in a deadlock by the Texas legislature. The redistricting lines were redrawn in 2001, but unfortunately, the political parties were not able to reach consensus, or cease accusations that the majority party in charge, the Republican Party, had redrawn the maps to their favor. Following the first failed attempt, the members of the Texas legislature agreed to try redrawing again in an effort to appease all parties in 2003; however, 11 Democratic members of the Senate absented themselves from the state for several days in May, as well as in August, to disallow a quorum. This had the desired effect to prevent the Texas Senate from voting on the two sets of completed district lines. Governor Rick Perry, then called a special session to finish the Constitutional mandated redistricting. Eventually, in January of 2004, the redistricting maps were completed, agreed upon, and passed after much turmoil, confusion, aggravation and lawsuits for all parties involved.

Historical Background

The United States courts were first introduced to the reapportionment issues by what is now known as the silent gerrymander, or the failure of the reapportionment portion of the government to redistrict after the previous census in 1960. The Supreme Court declared after *Baker vs. Carr*, 1963, that the failure to redistrict after a census might be a constitutional violation. According to Grofman, before this case some states

had not reevaluated their districts since the turn of the century, and some had not been redistricted for many decades. Some states had been keeping up during the 60's, however, with the provisions that the constitution had provided. Various states had constitutional provisions for one or both of the houses, and had combined geographic and population criteria. With the huge population shifts, all over the country, since the last redistricting, there were large variations in the sizes of the districts had occurred. In Tennessee, for example, the largest district was more than 40 times larger than the smallest district in the state. In California the ratio for the larges and smallest district was 449:1 in 1960. Two years after the *Baker vs. Carr* decision, the Supreme Court ordered that districts with unequal population were required to meet the "one-man-one-vote" decision that might make the districts much more equal in population. The actual law in the constitution that allows the Supreme Court to rule as they did is found in article I, section 2, which allows the Court the authority to impose the equal population standard in accordance to the 14th Amendment. Conversely, with the rule is to keep absolute population equality in congressional redistricting, the Court has allowed the states to use their own discretion in their own redistricting plans (Grofman, UCLA, 1985, 80). And here lies the "rub" for the individual states with problems deciding their own standard of criteria.

The Court has the ultimate deciding power for the percent deviation for redistricting plans. In 1983, the Court majority decided that if the criteria for redistricting were relevant and constitutional, then this would justify the population if the criteria were consistently applied (Grofman, 1985, 82).

Other States with the same issues in the past, Maryland for example had the 1993 court case of *Shaw vs. Reno,* which decided the constitutionality of the North Carolina's 12th Congressional District. This court decision was influential to have other districts around the country to be redrawn with more emphasis placed on geographic compactness (Webster, 2004).

Maryland had a challenge to their legislative redistricting plan in 1982. The court did not force a new redistricting plan because the districts in question had not reached the level of noncompactness that the state Constitution needs for a new redistricting plan (State of Maryland).

Geographic Information Systems (GIS)

Background with use of GIS in this redistricting problem is difficult to come by, which is concerning since GIS is used to redraw district lines. Considering GIS is used to draw the districts to begin with; it should also be used to dissect the districts again to search for inaccuracies and flaws. GIS has the ability to produce more unbiased districts and maps than a manually drawn map. Altman said, "Computers can prevent gerrymandering by finding the "optimal" districting plan, given any set of values that can be specified, claim proponents of automated redistricting" (Altman, 1997). GIS is a system that is specifically "designed for the manipulation, analysis, and cartographic display of spatially-referenced data" (Eagles, 2000). The redistricting in the 1990s was different than the decades past because of the use of GIS and the availability of census data. The major changes were in the "political and judicial context into which this new technology was introduced and within which districting plans were developed" (Eagles, 2000). The data that was needed for redistricting and the software to compute it was

available and ready to be put to the test in the 1990 redistricting of the United States. This "fair" district research will use GIS for the deconstruction of the redistricting of Texas in the 2001, and 2003 plans.

Geographic Information Systems is used in this "fair" district research as a tool to show visually the compactness measures in the State of Texas. GIS has long been associated with inanimate uses researching: "land and its use, water resources and systems, and transportation networks, but now people are finding that GIS is an invaluable tool for mapping and analyzing social problems" (Greene, 72). This includes being used for redistricting in not only the State of Texas but throughout the country. The Texas Legislative Council, or the TLC is in charge of the redistricting processes in Texas and they use GIS to create multiple district maps to test different layouts of districts to see the differences in the redistricting maps. "Some say that GIS can transform the way that social programs and services are designed and carried out in this country" (Greene, 72). Days before GIS, creating new maps especially redistricting proposal maps was an exercise in slowness, with each map being painstakingly transferred to paper maps and then on to 181 members (Greene, 50). It is evident that GIS is a useful tool for redistricting practices not only for speed sake but the ability to make multiple maps with different data and criteria with such ease makes it accessible to almost anyone. Texas chose to use GIS because of its size and the complexity of its redistricting efforts (Greene, 51). GIS can show not only the districts "but the underlying boundaries of census blocks or voting precincts." (Greene, 51) The ability for GIS to show not only the districts but what is beneath the districts has been invaluable for this 'fair' district research to analyze the data needed. Before the widespread availability and

acceptability to use GIS there were more limited ways of presenting the state of a city: statistics and raw numbers, with people don't understand or care about anyway, there were charts, which are definitive but can't show you where a problem it occurring (Greene, 72). This 'fair' district research used some number analysis but the more important and basis of this study was within the GIS analysis. Increasingly powerful geographic information systems used for redistricting enable political cartographers to rapidly draw and evaluate a large number of possible plans to find ones that, for example, create optimal partisan balances within and among districts (Forest, 426). This is similar to what this 'fair' district research has done. Balances were looked for through the GIS to see how the districts measured up. GIS was used to make maps of the intersections of the two plans. These maps show the two plans laid on top of each other which allow us to see what changes in district boundaries were made. "Although such systems have not changed the fundamental goals of redistricting, they have given practitioners unprecedented power to create districts with specific political and demographic characteristics" (Forest, 426).

Compactness in addition to the use of GIS is still a tricky situation with the non-consensus of which measures are the best to use in tandem. But, the TLC has attempted to pursue some of the measures even though the new redistricting does not reflect this attempt. "The TLC staff felt … that compactness might not be especially significant in 2001. As one staff member stated, "we weren't sure if compactness would be a "growth industry" in Texas (Forest, 439). "TLC included 3 gauges because in their view no single measure of compactness had been widely accepted by courts and no single measure captured a district's capacity for good-quality representation" (Forest, 439). "Claims

about the merits of compactness measure were politically strategic; the TLC sought to avoid endorsing any particular standard by including three that seemed to have some legal sanction" (Forest, 439). The TLC's use of GIS has made Texas a more comprehensive districting state, but the lack of use of measures that can be used within the GIS to create more researched and complete districts is still a downfall.

CHAPTER III

METHODOLOGY

Overview

This study looks at the question of geographic criteria and how instrumental it is in redistricting. To answer this question on geographic criteria, compactness is looked at in-depth. Geographic information systems (GIS) are used to derive the two most commonly used compactness measures of geographic dispersion and perimeter compactness measures.

Geographic dispersion and perimeter compactness measures are used in tandem because they measure different aspects of a district's compactness. Geographic dispersion measure "evaluates the spatial concentration of the area of a district. To calculate this compactness indicator, the smallest possible circle is drawn around the district. The resulting coefficient is the proportion of the area of the circle that is also in the district" (Webster, 44, 2004). Ultimately the scores of this indicator range from 1.0 as the most compact to 0.0 as the least compact. The perimeter compactness measure creates a coefficient for the "proportion of the area in the district relative to the area in a circle with the same perimeter" (Webster, 45, 2004). This measurement grades also on the scale from 1.0 to 0.0. Perimeter measurement shows the "irregularity that extends the boundary of a district without adding significant area" (Webster, 45, 2004).

GIS Methods

GIS is used to derive compactness measures. GIS determines the contribution of compactness in the two measures.

GIS: 1.) derives measures of compactness

2.) interprets the two plans (2001 and 2003) with two measures

3.) compares districts plans.

Methodology

Since the two plans are based on the same data (2000 Census), the measurements and comparisons used in this study are valid. Texas Legislative Council provided the district population data from census on their redistricting website. A visual inspection is made by looking at the 2001 and 2003 plans; for example, the districts that look like a piece of bacon are obviously not compact and those that almost look like a circle are more compact. Comparison strives to determine when a district is compact enough to be fair. Overlays in GIS evaluate how well compact districts leads to fair districts. This 'fair' district research used the perimeter and dispersion scores in the GIS to determine compactness scores. The overwhelming question is what is fair and how can we judge it and measure it? The large assumption is that districts are fair by grouping ethnicities together. This assumption might not be a fair one in all circumstances. This study makes the following assumption: 'fair' districts can be defined in accordance with the basis of the Supreme Court decision of *Baker vs. Carr* (1963).

The other component of geographic criteria is contiguity. To measure contiguity there is a visual examination of the Texas district map and GIS to evaluate the impact of the underlying geographic structure with layers such as: population distribution, districts

and physical features. The concentration is placed on the visually obvious potential problem areas. For example, Monmonier describes several situations that are unavoidable problem areas like a lake that divides two cities, but it can also be drawn to combine the two cities to allow for more representation. This squiggly lake line has potential to not be drawn to promote minority representation (Monmonier, 2001).

Summary

Using Texas as a case study is an excellent way to see the 2001 and 2003 district maps with same data. This is a unique opportunity to evaluate the controversial geographic criteria and redistricting issue in Texas. This same application with the criteria can be used anywhere in redistricting situations. The geographic criteria help determining 'fairness'.

CHAPTER IV

ANALYSIS

Discussion of Compactness

Monmonier dedicated an entire chapter in his book to "Gauging Compactness" (Monmonier, 2001). He states that "it is tempting to suggest a formal standard for compactness: a definition separating the illegally irregular from the geographically gauche…although we know it when we see it, individual sensitivities and community standards vary widely" (Monmonier, 64, 2001). He, as well as Webster, presents the fact that there are over two-dozen different measurements of compactness, but there are two that are the most widely used and complementary to each other that will result in a description of the irregularities of political districts. There is no general agreement of compactness measures acceptance among those who use it regularly, but these two that are used are the most popular in the literature that this 'fair' district research found. These indexes are equations that are based on simple geometric definitions, like a circle and a perimeter, which would result in the basic "dimensions of a closed geographic boundary" (Monmonier, 65, 2001).

Measuring compactness is cause for great debate between geographers, political scientists and political geographers. Compactness is a multidimensional task, which causes discussion over which dimensions are the most relevant and needed to create a fair

district (Niemi, 1990). This paper will discuss several of these measurements to allow for a deeper understanding of each measurements and its definition, limitations and strengths. Quantitative measures of compactness compare each shape of each district to some sort of standard; generally this standard is a circle because the circle encompasses the most area for its perimeter length. Obviously a chain of circles cannot form a set of compact districts into a state, so sometimes a hexagon is used as the standard shape. Regardless of any sort of a standard shape, the main point to keep in mind is that the dispersion of the district must be considered (Niemi, 1990). Dispersion must be considered to allow the compactness measure to help districts become more 'fair'. Compactness of districts is an indicator of 'fairness' because compactness suggests a lower probability of gerrymandering and any sort of tampering with a districts shape that would allow the furthering of specific political agendas.

In much of the literature on this topic, the overall consensus of the experts is that all measures of compactness fall short of being the ideal multifaceted measure of compactness. They also agree that if a dispersion measure and a perimeter measure were combined, they would be more able to measure the districts with some ability to look at the majority of the pertinent issues in compactness.

The complicated districts need to be measured but are difficult because of the shape of the district, such as a district that might look like a salamander with tentacles and fingerlings all over the district. These types of districts are concerning because of their potential to exist for gerrymandering purposes. For example, these fingerlings might exist to encompass a certain group of people to be added to a certain politician's district to boost his electoral numbers or to harm his opponent.

Measurements of dispersion alone are not sufficient to accurately measure compactness because they are insensitive to the perimeter inconsistencies that may occur. Therefore, incorporating perimeter measurements are a necessity to more accurately measure a district's compactness. Morrill says that "It is quite difficult to gerrymander compactly" (Morrill, 21, 1981). This statement tells us plain and simple that compactness is some what of a deterrent to gerrymandering, but also it must be said that "a compactness criterion is not necessarily a guarantee against gerrymandering" (Morrill, 21, 1981). Although compactness can help to not allow gerrymandering, it is not a fail proof tool. "Many statisticians and geographers as well as critics and reformers of electoral abuse have stressed compactness both as inherently desirable and as a defense against gerrymandering"(Morrill, 21, 1981).

This research incorporates the mapping of spatial factors in the decisions to redraw redistricting boundaries as a useful device for ensuring that 'fair' criteria are met and utilized. This 'fair' district research evaluates the previous two plans drawn in 2001 and 2003 by the State of Texas to assess whether these districts were drawn "fairly" based on established criteria. The Texas Legislative Council is in charge of the mapping of Texas districts. Therefore, special attention was focused on how the TLC arrived at the redistricting lines. In an online document the TLC states that Geography reports were made and included the geographic criteria. They say that geographic data are compiled, including compactness, but since no real consensus can be made on what measurement to use the data will only be "eyeballed" and taken into consideration by each person who is in charge of an area in the redistricting process (TLC 2, 7).

This 'fair' district research went even further and used a fairly common and accepted measure of compactness and determined a level of compactness for the 1151 and 1374 plans. Compactness has been defined as the criterion that "focuses on the district's shape and the degree to which its area is dispersed around its core" (Webster, 43, 2004). The two indices that measure compactness are dispersion score and perimeter score. The definition of dispersion measure for the case of this paper is that these measures should assess how spread out a district is or how tightly knit the district is. The assumption is always that there is the potential for the perfect district, and that district is regular and usually a circle. The difficulty is to decipher the best way to use the best measurement for the perfect shape. The multiple methods of measurement exist because of the different shapes that might be used. Perimeter score measures the perimeter of a district and is used with the dispersion score to calculate a measure of compactness.

GIS Used in this Research

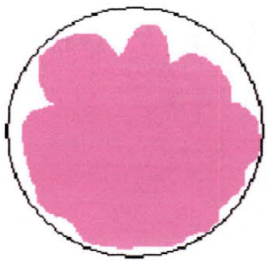
Geographic Information Systems (GIS) is used to derive these two most commonly used compactness measures of geographic dispersion and perimeter compactness measures. These indexes will be used in this "fair" district research. Dispersion score is measured by dividing the area of a district by the area of the smallest circle that totally surrounds the district. The circle is used for a guide in compactness because it shows considerable features between shapes that are compact and those that are thin and irregular elongated shapes. GIS is used to intimately look at the two Texas redistricting plans. ArcGIS was used to: show graphically the basic layout of the two plans, show how the intersection of the two plans differs greatly, calculate the compactness numbers in the field calculator, show in a choropleth map the range of

compactness numbers of both plans, and calculates breaks in the compactness numbers to show a variation in range of compactness for both plans. This research shows the intersection of the two plans and this is especially interesting and unique because both the plans are based on the same Census data. All these different aspects are looked at in the GIS because of the spatial capabilities that GIS allows the user to see. The intimate look at the two plans gives a unique perspective of the compactness issues in Texas during the specific time frame. Showing the intersection of the two plans shows literally the two plans laid on top of each other to show the common areas to the two plans as well as the differing areas.

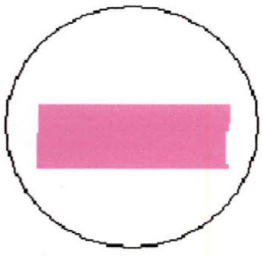
Compactness in Texas

This 'fair' district research examines strictly the geographic criteria as it was applied to 2001 and 2003 plans drawn by the Texas Congress. These numbers, as they were calculated from Webster's compactness measurement, form the basis of this research. The data shows evidence of compactness of districts.

Scoring a complete one on the compactness scale would be a perfectly compact district; conversely scoring a zero would be the least compact district.



Dispersion= .87
Perimeter= .77



Dispersion=.12
Perimeter=.26

Dispersion=.78
Perimeter=.18

The numbers were calculated from the dispersion and perimeter numbers of the districts. The perimeter numbers were calculated in the GIS with a simple equation. The dispersion scores were part of the Census database. These numbers were combined into the equation given by Webster $\frac{4\pi(Area)}{Perimeter^2}$ (Webster, 2000). The calculated compactness values for the tow plans ranged from 0.523 to 0.084. These scores were as expected, but it is very revealing to see them on the maps showing each district for its actual compactness.

What can be seen with the two plans visually is that plan 1151 overall was more compact than the 1374 plan. The court ordered plan (Plan 1151) has an average compactness measure of 0.2657, while the new plan (Plan 1374) had an average compactness measure of 0.1787. (See figures 3 & 8) Visually, Plan 1151 has more districts that are less looking like 'pieces of bacon' than the 1374 plan. In the 1151 plan the valley area of South Texas is especially more visually compact and has higher compactness numbers. This area was an area of initial concern because of the obvious shapes of the districts, and the plan 1374 has created more elongated districts that are less compact.

According to Webster's interpretation method of compactness there is no absolute scaling to evaluate compactness coefficients. He suggests that the analysis be done as a comparison to average levels calculated over a length of time. This 'fair' districting research is extraordinary in that the two plans are being analyzed from the same census data. The compactness measure for the two plans show that they are not similar in their levels of compactness that they are based on the same years Census data. Although the two plans are similar because they are based on the same Census data, they are not

similar in their levels of compactness. Webster says that a compactness analysis must be interpreted in the light of the geographic setting that is being districted (Webster, 2004). This is particularly interesting in this research because of the complicated areas in Texas, such as the large metropolitan areas and the tricky valley districts. Webster's interpretation methods of the measurements of compactness help dissect the redistricting issues in this 'fair' district research. Webster encompasses major points that cannot be disregarded or treated lightly. He discusses the fact that looking at geographic areas is essential. It would be easy to just look at the plans for what they are with no regard to what is "beneath" them, including: cities, counties, and census blocks that encompass these districts (Webster, 2000).

As can be seen in Figure 8, the major metropolitan areas are at the crossroads of many districts. Upon closer examination of Houston, San Antonio and Dallas-Ft.Worth, some of the most highly populated areas included some of the lowest compactness scores. Dallas and Houston are included in multiple districts, some being measured in the intermediate range and some on the lowest end of the scale. San Antonio is almost completely on the lowest end of the scale as opposed to the near by Austin that is at the moderate range.

Plan 1374 on figure 3, in contrast, had lower total numbers than 1151. The new district lines in Dallas as well as Houston show that this court ordered plan has lower compactness numbers in total. San Antonio and Austin are also included in the lower ranks of this plan. Obviously the current plan, 1374, is not more compact which leads to a not more 'fair' district plan based on the geographic criteria of compactness. The data that was calculated from 1151 and 1374 moved in a downward trend which technically

and, with the aid of maps, visually, states that as far as compactness goes for the court ordered plan, it doesn't not make for a more 'fair' districting plan.

CHAPTER V

SUMMARY AND CONTRIBUTIONS

How this Study Contributes to the General Knowledge of the Field

This research has demonstrated that an evaluation of Webster's interpretation of compactness measures is a tool that can be used for creating 'fair' districts. It also uses the ideas of Monmonier. The combination of Webster's interpretation of compactness and Monmonier's ideas on physical landscape makes this research more complete and encompasses spatial ideas with the use of GIS. Emphasis is given to the importance of spatial dimension for compactness and contiguity. Spatial dimensions tend to be over looked in redistricting research, but this 'fair' district research uses the geographic criteria to critique compactness measures in the state of Texas. From a geographic perspective, compactness is important because it is a geographic indicator of 'fairness' in districts. The more compact a space is the shorter distance from other locations that are homogenous to that space. The relationship between compactness and homogeneity is simple but is often over looked. Simply put, the closer two areas are the more likely they will be similar and the tighter that an area is the more likely the entire area is similar. This is why compactness is used so frequently in applications like redistricting.

This research has potential to be expanded to have a more complete districting plan using more than the 2001 and 2003 redistricting plans in Texas. Perhaps a decade or more of data could be used to show more comprehensive results of Texas and its compactness. This research could be a benchmark to politicians in allowing them to see that more needs to be done in the redistricting arena. Hopefully the politician would see that more attention to details in attempt to make districting plans not only just constitutional but also more 'fair' and representative of those who live in the districts. This research appeals to political scientists who might not be aware of the geographic tools that are at their disposal to evaluate redistricting plans.

More emphasis needs to be focused on the geographic criteria of redistricting because it inevitably does make for a more "fair" district by disallowing gerrymandering and keeping the districts from encompassing people in a 'bacon strip' manner (Morrill,21, 1981). Compactness is not the answer for all 'fairness' in redistricting, but it can help to show visually and mathematically how plans have unresolved issues that could be addressed easily. "A good redistricting plan is one that distributes political power as equitably as possible among all groups" (Webster, 46, 2004). Compactness helps bring the groups of people together by attempting to create a more 'fair' district, with tight lines around similar groups of people.

How this Study Contributes to Literature

This study contributes to the body of literature by specifically examining Texas in attempt to create "fair" districts with use of the criteria set by the government more specifically the geographic criteria of compactness that was directly studied in the Texas 2001 and 2003 district plans. This study provides a non-partisan look at redistricting

plans. It answers lingering questions about whether the current plan can be considered 'fair' based on geographic criteria. Texas is a good choice for this redistricting examination because redistricting in Texas is unusual in that there have been two redistricting plans based on the same Census data. Generally, redistricting is only done once a decade, Texas provided an extraordinary exception. This allows this 'fair' district research to examine two different plans, based on the same population distribution values, to compare their level of compactness, hence their levels of 'fairness' in terms of geographic criteria.

Summary of Results

There is an expectation, from looking at Texas as a case study, that there would be some clear distinction that one plan is superior to the other plan and that plans would be declared to be fair or not fair relative to each other however the differences between the two plans in compactness is slight. Assuming that this is possible, however the research shows that Texas is far from achieving 'fair' districts. After a thorough examination of the State, its compactness measurements and the literature from the TLC, it is obvious that Texas has much to be desired in compactness. Overall, in both plans and the reviewed literature, it is clear that compactness was not an issue considered in the redistricting plan. Neither plan is superbly superior to the other, but between the two, 1151 has higher compactness numbers and less problem areas visually and technically.

Most of the literature points to a theoretical attempt to create "fair" districts; this paper with the use of geographical criteria looks at the actual success or failure in the case of Texas. In accordance to the results found from the analysis of compactness in the

two plans in this 'fair' district research, it is the position of this researcher that the new court ordered plan 1374, is not a more 'fair' districting plan.

This research might be extended to include more than just Texas and more than just comparing the two plans. A national examination of multiple plans, over a period of time, would enable a larger analysis to more accurately the state of compactness in redistricting is in the United States. This research points to severe deficiencies in current compactness measures. Future research will focus on developing a new compactness measure that deals with these deficiencies by taking the underlying legally imposed census block boundaries and population distribution into consideration. While Texas is being used as a case study it would be very easy to adapt this research to other locations. This study might be extended to include more than just the geographic criteria and could include the full spectrum of political, political-geographic, geographic, and constitutional criteria.

Texas still has a lot to be desired in the compactness arena, but as shown in this "fair" district research, with some further examination, more direct focus and a serious attempt to include geographic criteria into a districting plan, there is hope for a better, more compact Texas districting plan.

APPENDIX A

Definition of Terms

Redistricting- the process of redrawing district lines with the consideration for the Constitution's plain objective of making equal representation for each district. It is a reallocation of seats in the seats of Congress every ten years.

Gerrymandering- the redrawing of the district lines with intention to deliberately increase the number of districts in which a particular party is the majority.

Reapportionment- reallocation of the House seats among the states.

Criteria- practices advocated by the Federal and State governments that might deter the possibility of a gerrymander in districts.

"Fair" district- based on the 14th Amendment of Equal representation.

Compact district- a district that has the boundaries of each district as short as possible- focuses on a district's shape and the degree to which it's area is dispersed around its core. (Webster, 2004) the ideal being a district with every point along its boundary being of equal distance from its center. A circle is the most compact shape for a district (State of Maryland).

Contiguity- Traditional redistricting principle referring to whether or not all parts of a district are connected to each other (State of Maryland).

Voting Rights Act of 1965- a federal statute that with the power of the 15th Amendment disallows State election laws that do not allow voters to vote on account of race or color.

APPENDIX B- FIGURES 1- 11

FIGURE 1- Intersection of Plans 1151 and 1374

FIGURE 2- Plan 1374

FIGURE 3- Plan 1374 Compactness

FIGURE 4- Plan 1374 and Dallas- Ft. Worth

FIGURE 5- Plan 1374 and Houston

FIGURE 6- Plan 1374 and San Antonio and Austin

FIGURE 7- Plan 1151

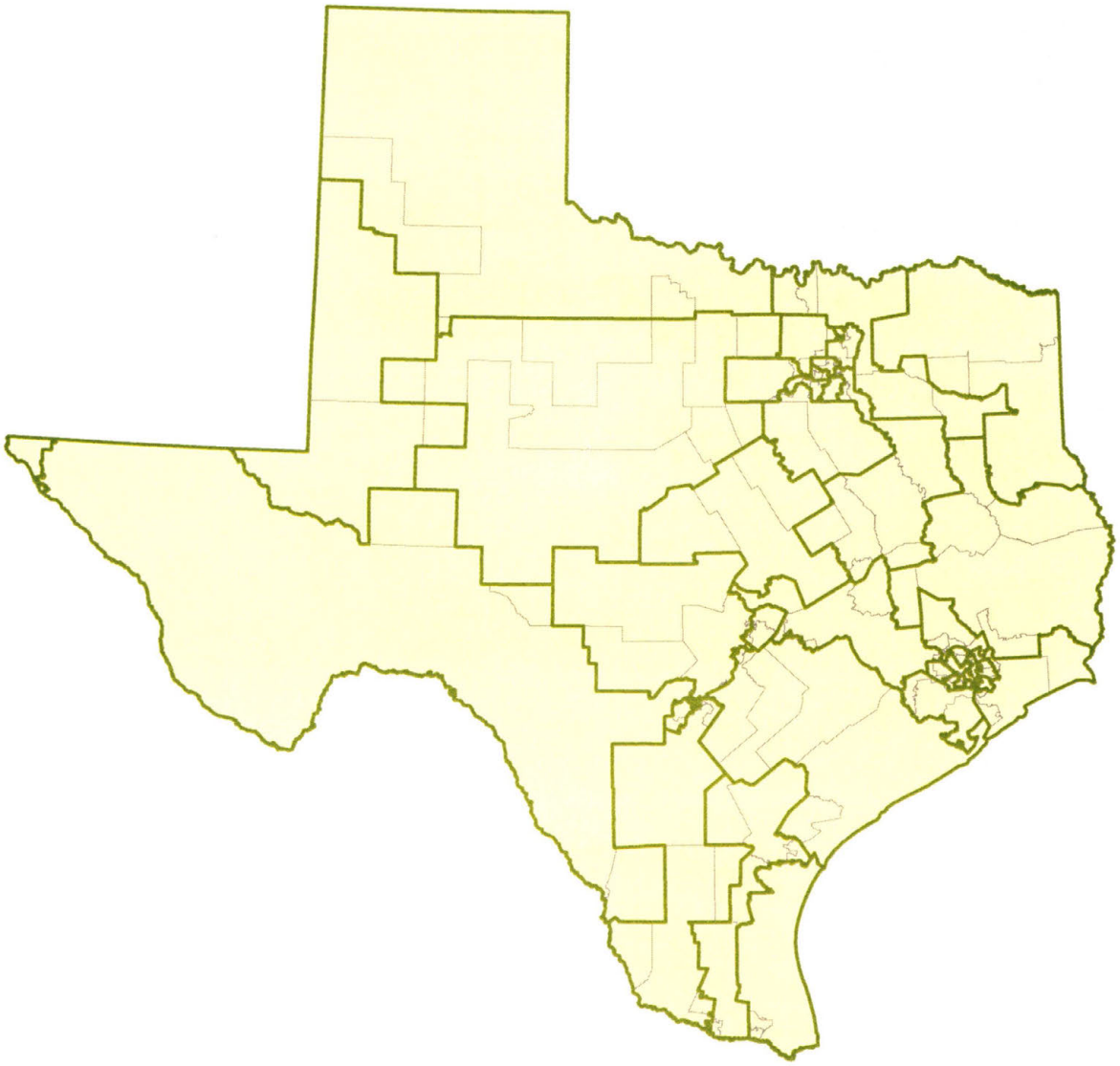
FIGURE 8- Plan 1151 Compactness

FIGURE 9- Plan 1151 and Dallas- Ft. Worth

FIGURE 10- Plan 1151 and Houston

FIGURE 11- Plan 1151 and San Antonio and Austin

Figure 1
Intersection of Plans 1151 and 1374



1151 and 1374

perfect1151

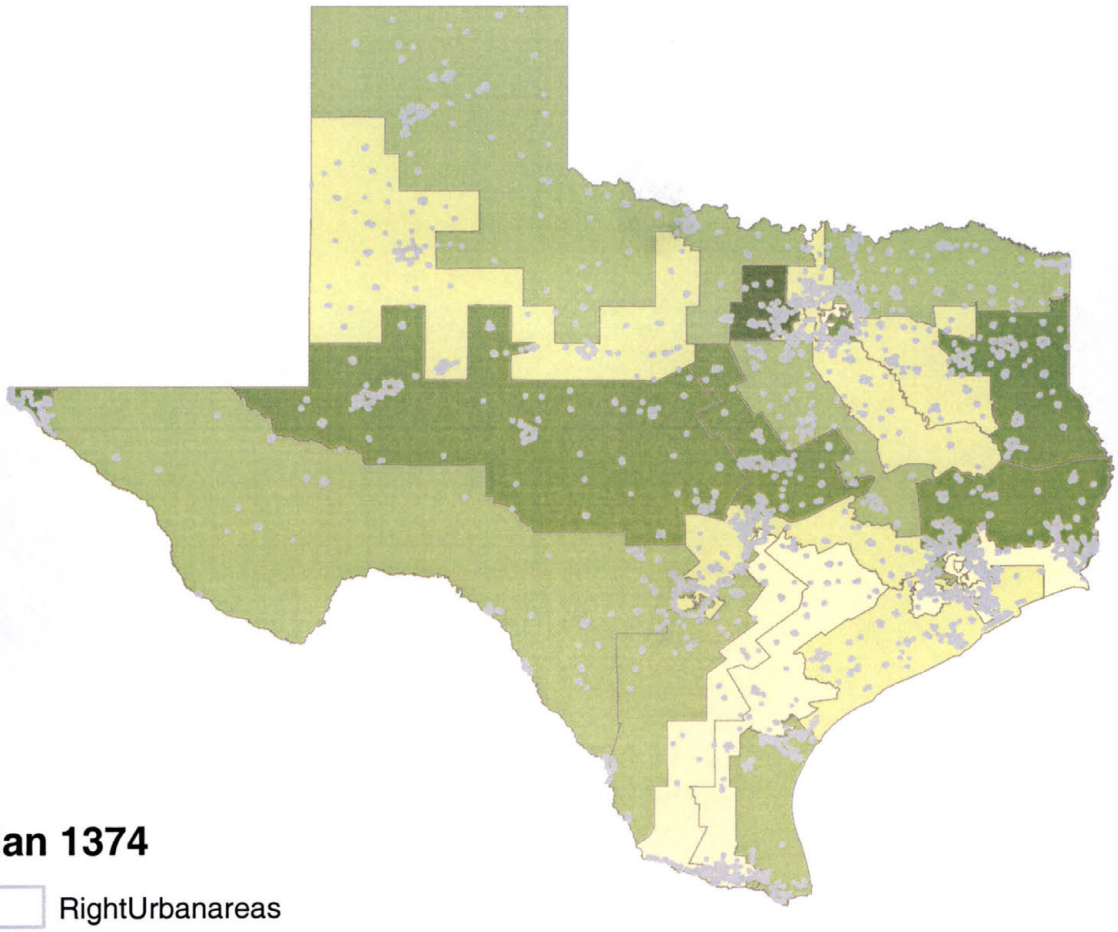
perfect1374

Figure 2
Plan 1374

Plan 1374

perfect1374

Figure 3
Plan 1374 Compactness and Urban Areas



Plan 1374

RightUrbanareas

repro1374

COMPACTNES

- 0.084928 - 0.129726
- 0.129727 - 0.187307
- 0.187308- 0.241271
- 0.241272 - 0.335352
- 0.335353 - 0.523658

Figure 4
Plan 1374- Dallas-Ft. Worth

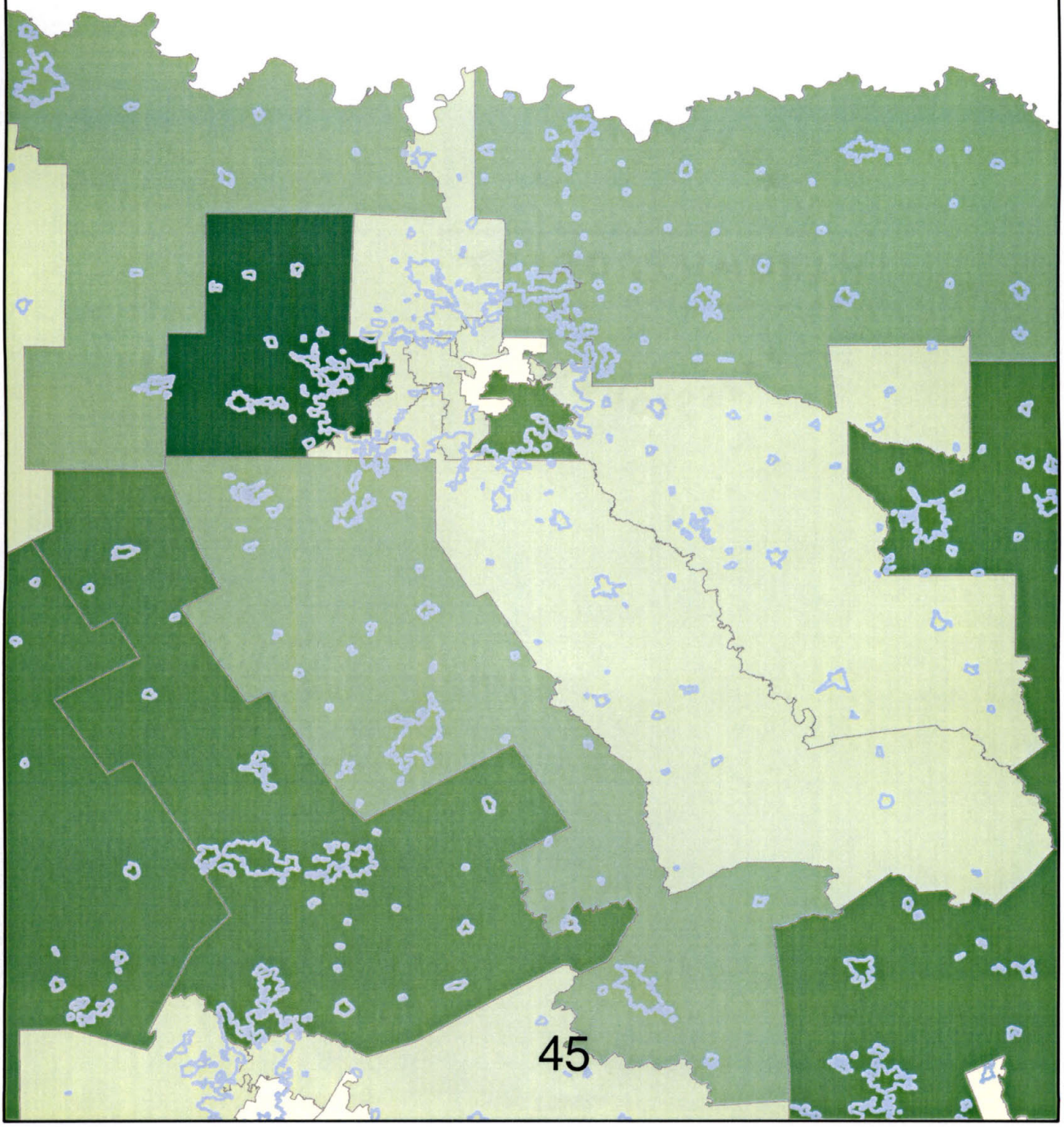


Figure 5
Plan 1374- Houston

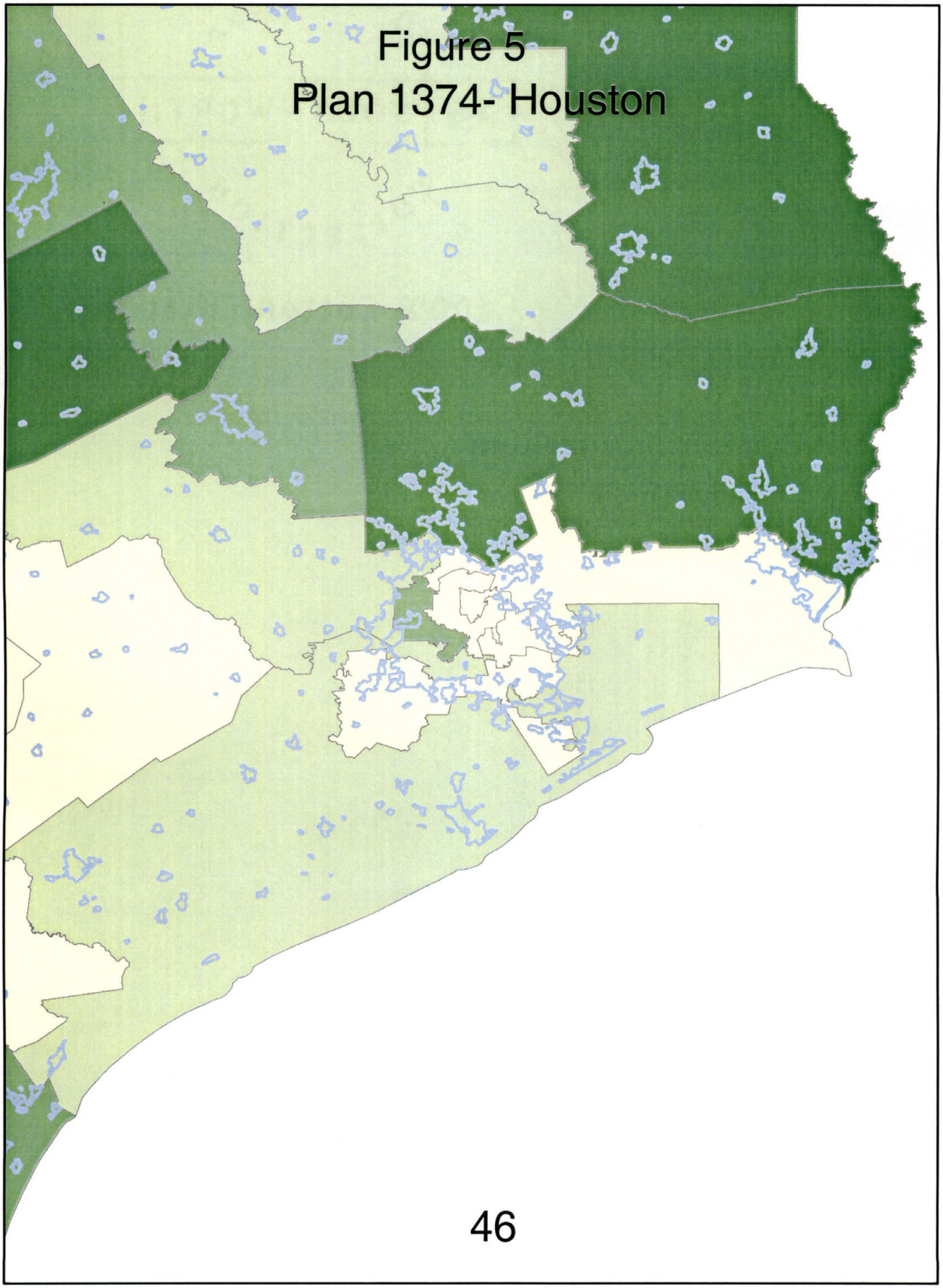


Figure 6
Plan 1374- San Antonio- Austin

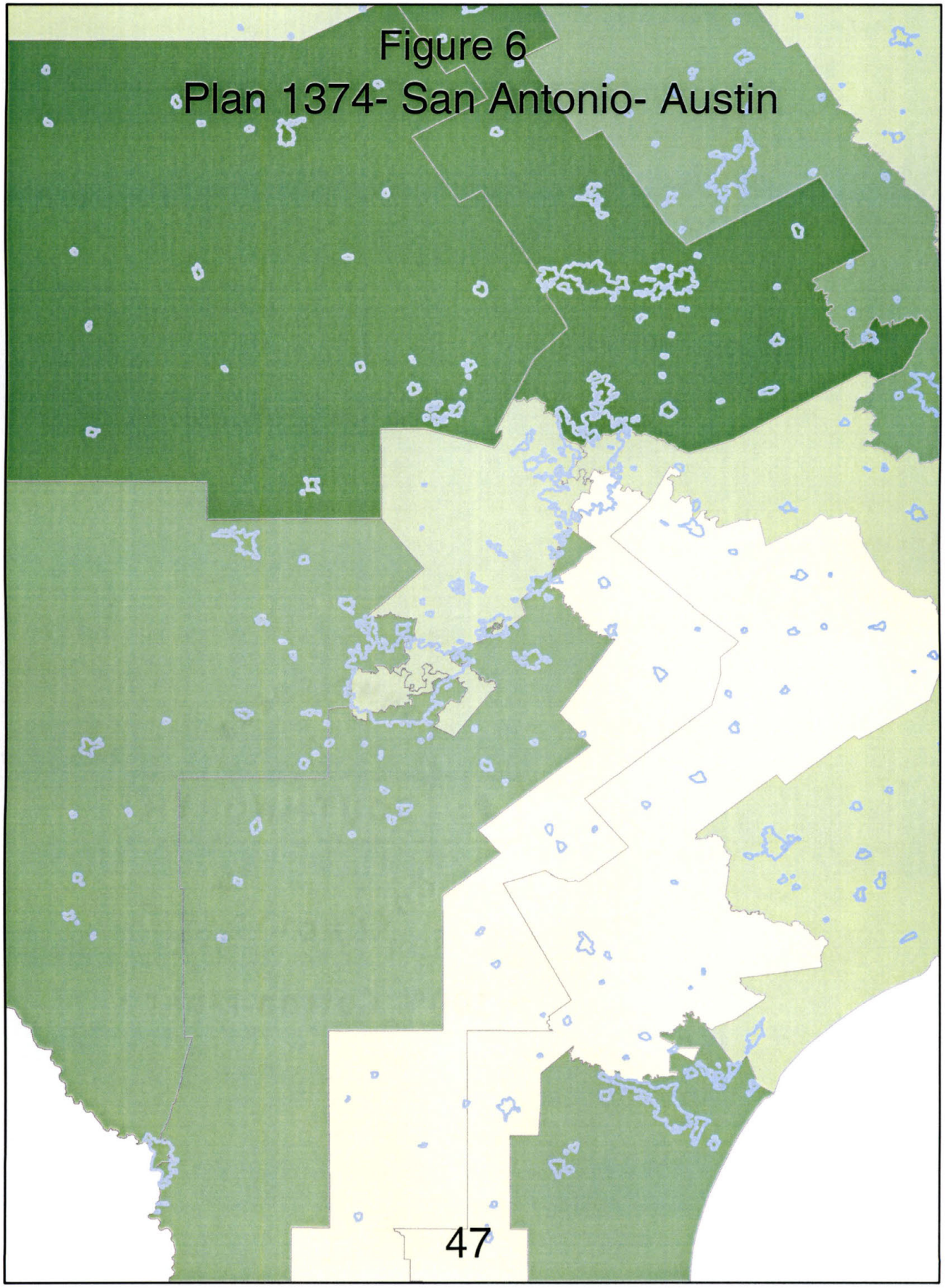
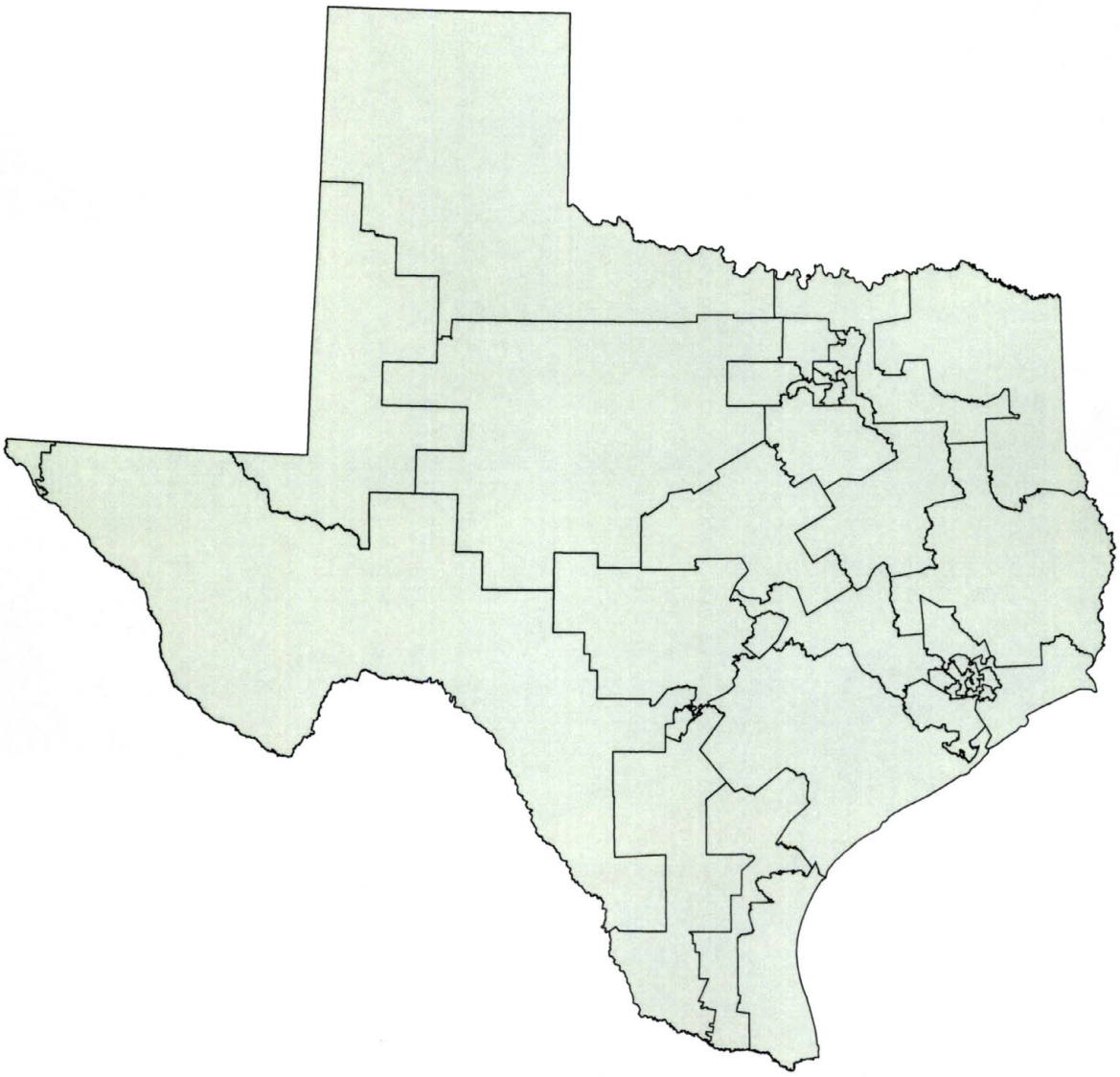


Figure 7
Plans 1151



Plan 1151

perfect1151

Figure 8
Plan 1151 Compactness Measurements

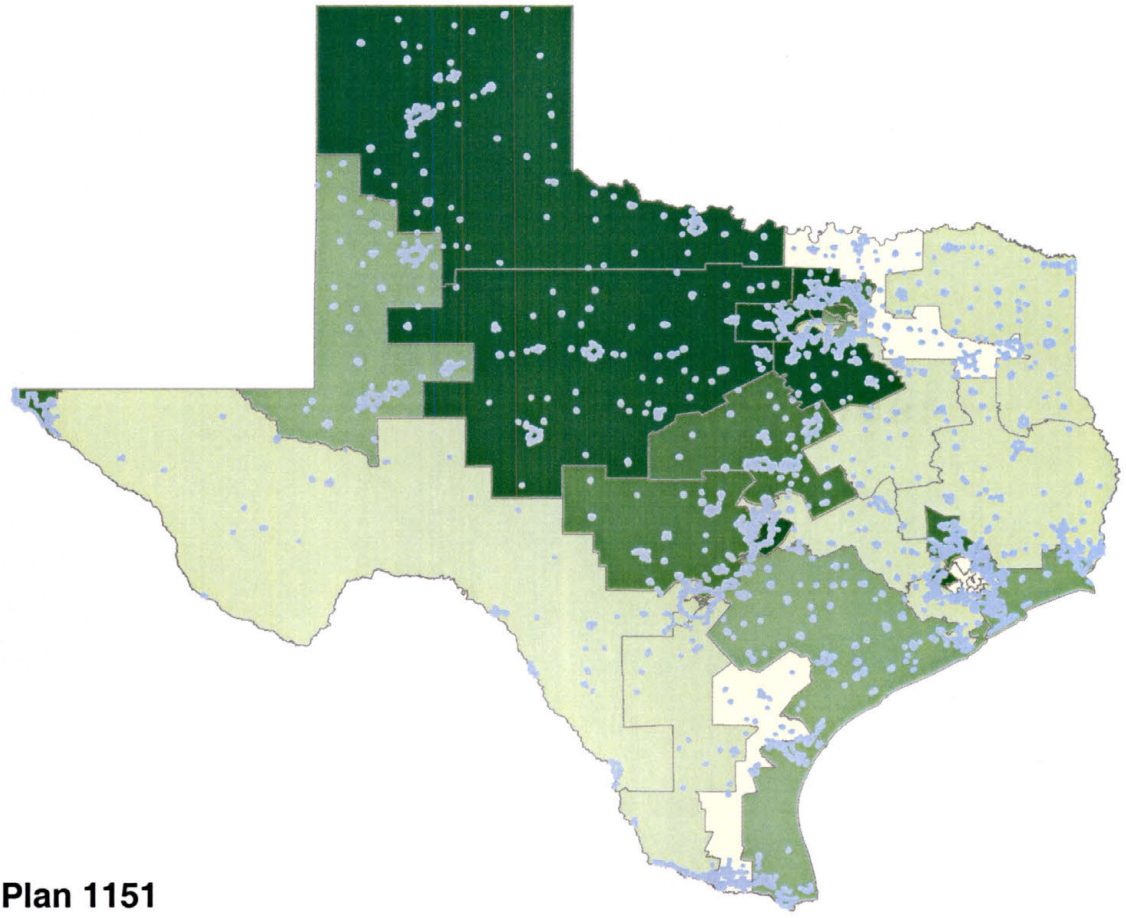


Figure 9
Plan 1151- Dallas-Ft. Worth

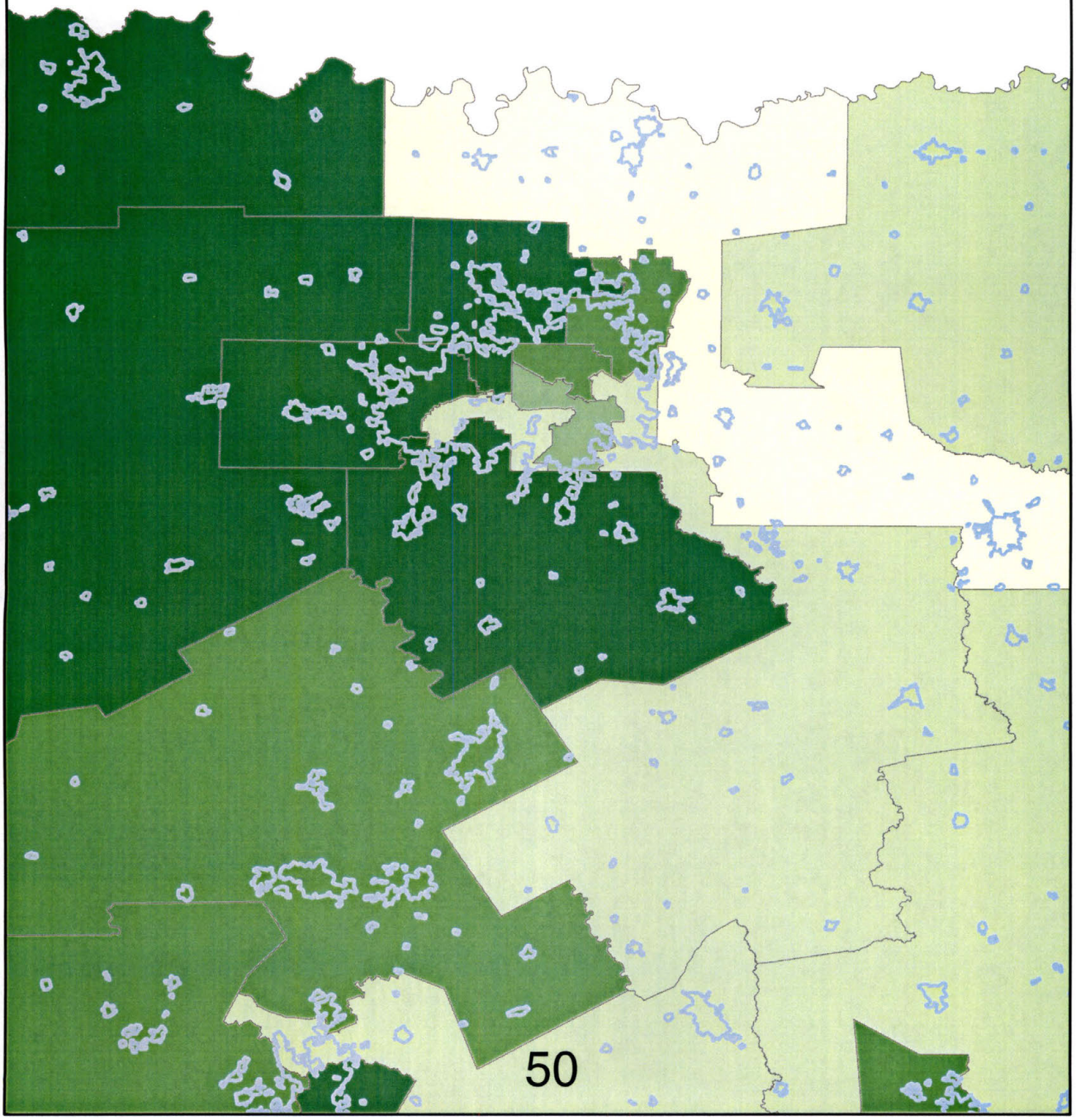


Figure 10
Plan 1151- Houston

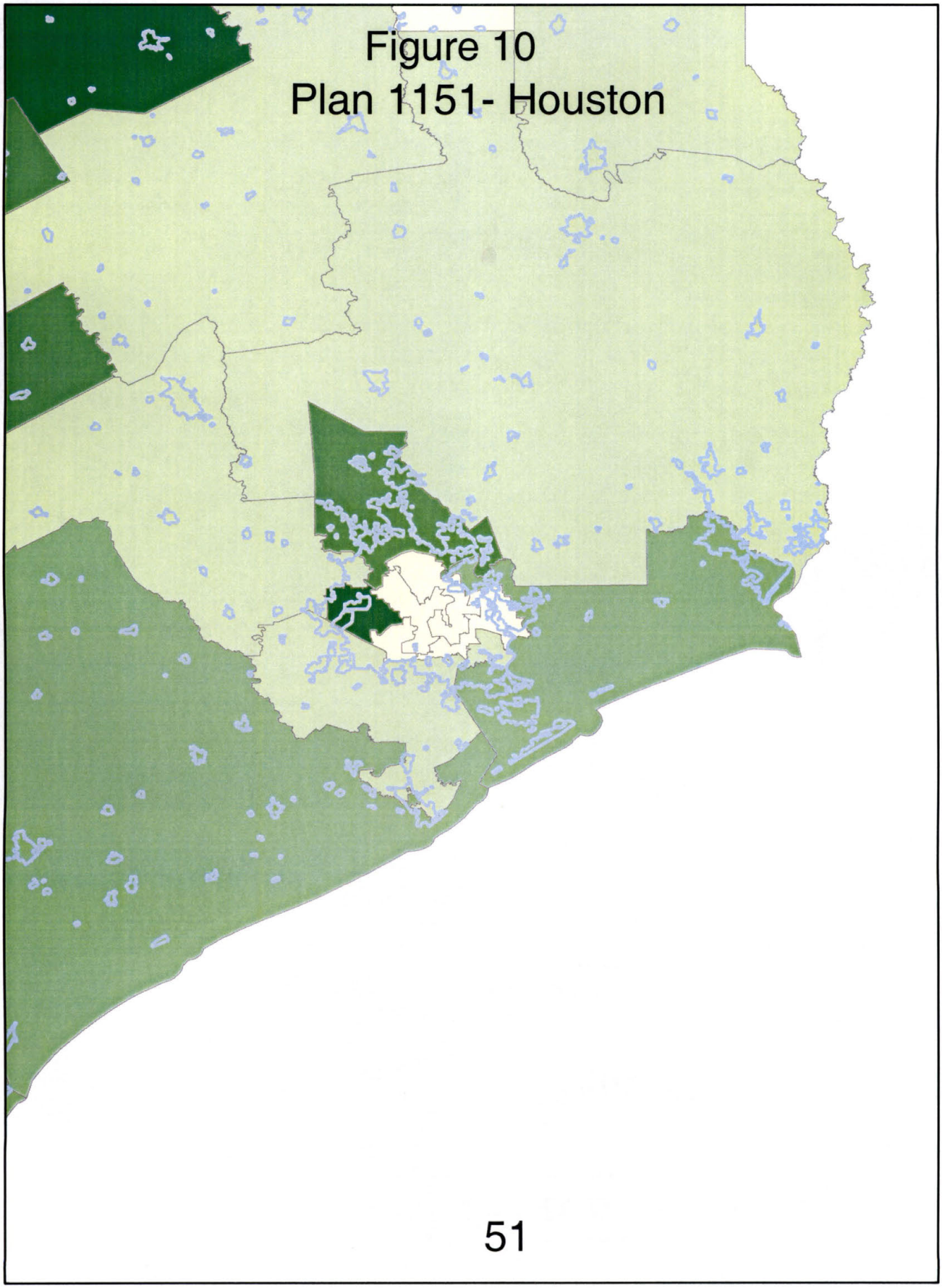
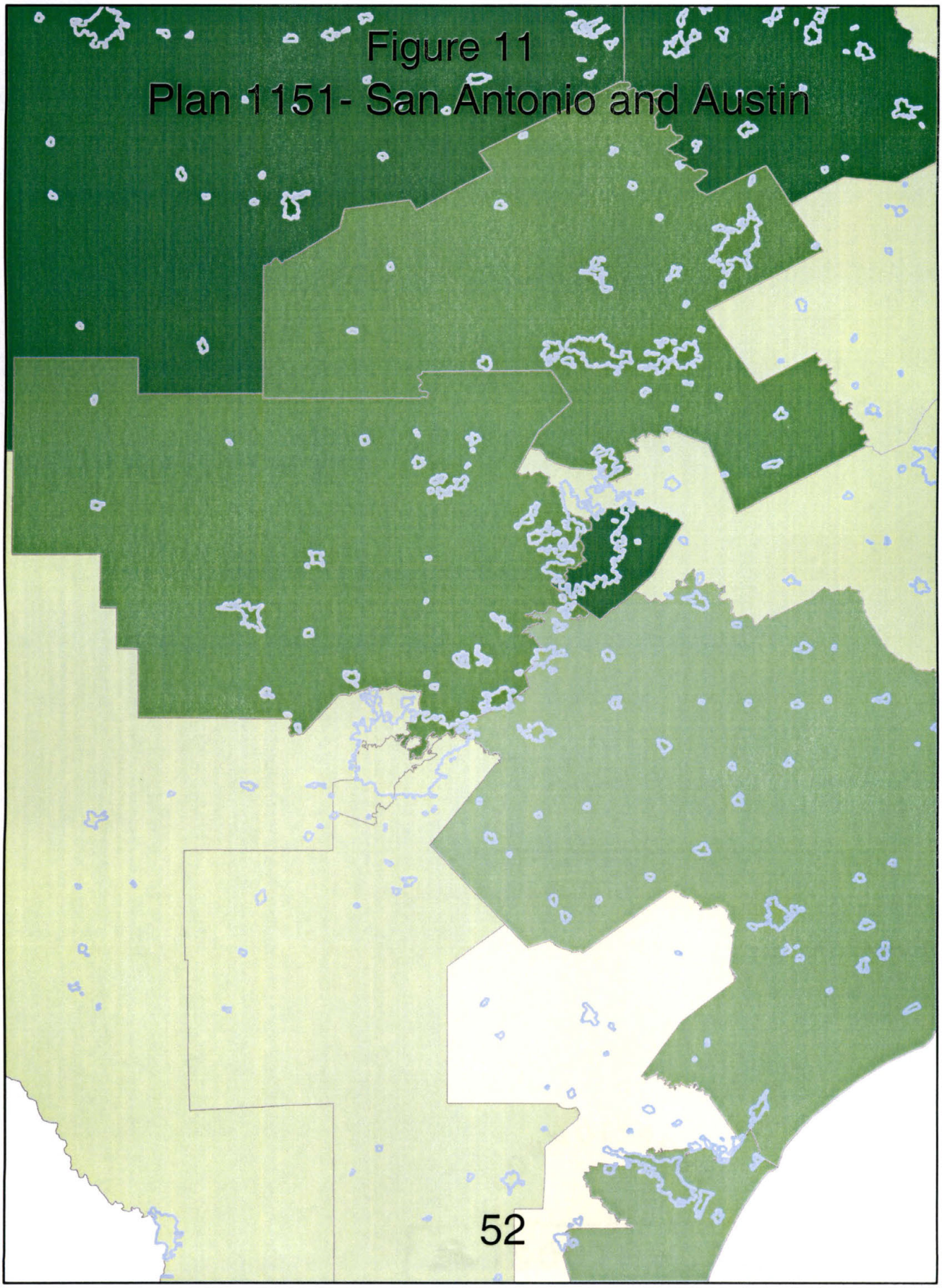


Figure 11
Plan 1151- San Antonio and Austin



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VITA

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Education

Texas State University- San Marcos
Masters of Science, Geography, December 2004

Thesis title: GEOGRAPHIC CRITERIA IN REDISTRICTING TEXAS 2001, 2003

Primary Advisor: Dr. Deborah Bryan

Southwest Texas State University
Bachelor of Science, Geography, August 2002
Dean's List: 4 semesters

Course Highlights

Population Geography This class studied spatial distribution and movement of human populations. Emphasis on current issues and analytical techniques.

Geographic Information Systems I This course studied the analysis and interpretation of maps stored in digital form, study on cartographic issues, data manipulations and modeling.

5318 Environmental Problems of the U.S.-Mexico Border This course was an introduction to the physical, social and environmental landscapes of the region. This course uses the application of an interdisciplinary perspective to geographic understanding of the environmental and health-related issues experienced by residents of the borderlands.

Research Experience

Texas State University- San Marcos, Department of Geography
Research Assistant, August 2002-May 2003, August 2003-May 2004

Investigated GIS data for publication of a lab manual for beginning GIS Labs in University. Prepared labs for teaching in GIS. Researched multiple Professor's work including focus on GIS data, database organization and compilation, waste management, historical data for water issues and a Texas music history.

Technical Expertise

Geographic Information Science: GIS is a computer-based hardware and software system for the entry, editing, updating, analysis and graphic display of locational information. GIS has evolved into a technology that can help people plan, design, engineer, build, and maintain information infrastructures.

Computer Experience: years of experience of Arc View, Arc GIS, Microsoft Word, Excel, PowerPoint, and Endnote

Teaching Experience

Texas State University- San Marcos
Teaching Assistant, Department of Geography, 2002-2003
Introduction to GIS (2 Semesters)

Presentations

Association of American Geographers
99th Meeting, New Orleans, LA
"An Analysis of the New Braunfels, Texas Floods of 1998 and 2000"

Service

Professional Associations

Association of American Geographers 2002- present

Volunteer Work

Mission work in Mexico weekend retreats through Sigma Phi Lambda a service oriented sorority 2000-2001

Mission work in underprivileged areas of Memphis, house reconstruction. UUMC, 1997-1999